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April 2017

ON Semiconductor®

FNB50560T1

Motion SPM® 55 Series

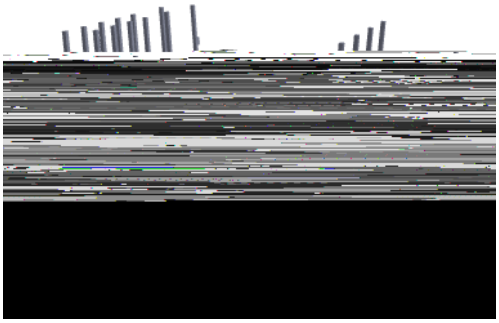
Features

- UL Certified No. E209204 (UL1557)
- 600 V - 5 A 3-Phase IGBT Inverter Including Contro TJ1.04 -1.22 TD.0017 Tc.00060017tApplications • Motion Control , Home A

General Description

FNB50560T1 is a Motion SPM 55 module providing a

Related Resources



Integrated Power Functions

- 600 V - 5 A IGBT inverter for three phase DC / AC power conversion (Please refer to Figure 3)

Integrated Drive, Protection and System Control Functions

- For inverter high-side IGBTs: gate drive circuit, high-voltage isolated high-speed level shifting control circuit Under-Voltage

Pin Descriptions

Pin Number	Pin Name	Pin Description
1	P	Positive DC-Link Input
2	U, V_S(U)	Output for U Phase
3	V, V_S(V)	Output for V Phase
4	W, V_S	

Internal Equivalent Circuit and Input/Output Pins

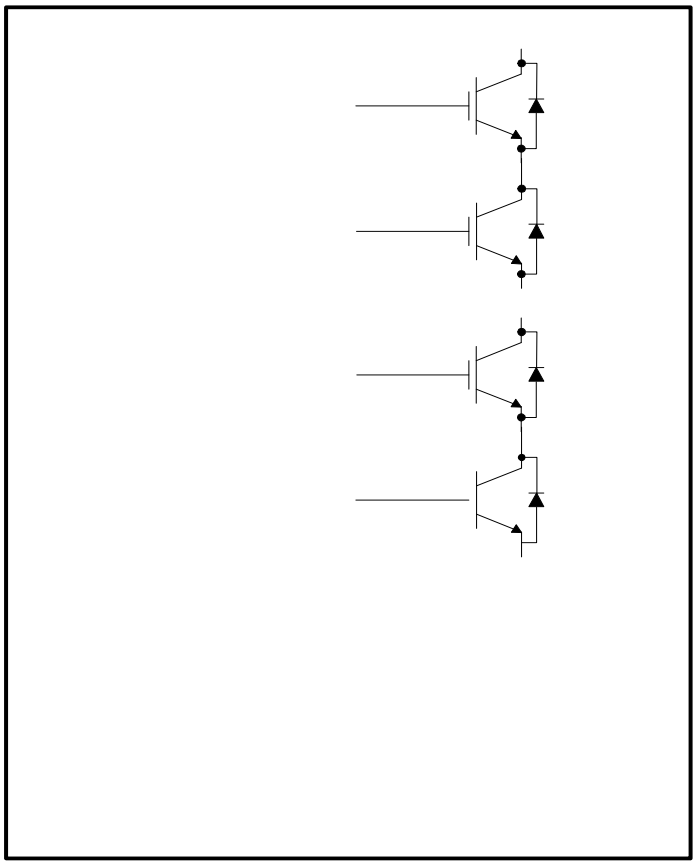


Figure 3. Internal Block Diagram

Note:

1. Inverter high-side is composed of three IGBTs, freewheeling diodes, and one control IC for each IGBT.
2. Inverter low-side is composed of three IGBTs, freewheeling diodes, and one control IC for each IGBT. It has gate drive and protection functions.
3. Single drive IC has gate driver for six IGBTs and protection functions.
4. Inverter power side is composed of four inverter DC-link input terminals and three inverter output terminals.

Absolute Maximum Ratings (T_J = 25°C, unless otherwise specified.)

Inverter Part

Symbol	Parameter	Conditions	Rating	Unit
V_{PN}	Supply Voltage	Applied between P - N_U, N_V, N_W	450	V
$V_{PN(Surge)}$	Supply Voltage (Surge)	Applied between P - N_U, N_V, N_W	500	V
V_{CES}	Collector - Emitter Voltage		600	V
± I_C	Each IGBT Collector Current	T_C = 25°C, T_J 150°C	5	A
± I_{CP}	Each IGBT Collector Current (Peak)	T_C = 25°C, T_J 150°C, Under 1 ms Pulse Width	10	A
P_C	Collector Dissipation	T_C = 25°C per Chip	19	W
T_J	Operating Junction Temperature	(Note 5)	-40 ~ 150	°C

Note:

5. The maximum junction temperature rating of the power chips integrated within the Motion SPM® 55 product is 150°C.

Control Part

Symbol	Parameter	Conditions	Rating	Unit
V_{DD}	Control Supply Voltage	Applied between V_{DD} - COM	20	V
V_{BS}	High-Side Control Bias Voltage	Applied between $V_{B(U)}$ - $V_{S(U)}$, $V_{B(V)}$ - $V_{S(V)}$, $V_{B(W)}$ - $V_{S(W)}$	20	V
V_{IN}	Input Signal Voltage	Applied between $IN_{(UH)}$, $IN_{(VH)}$, $IN_{(WH)}$, $IN_{(UL)}$, $IN_{(VL)}$, $IN_{(WL)}$ - COM	-0.3 ~ V_{DD} +0.3	V
V_F	Fault Supply Voltage	Applied between V_F - COM	-0.3 ~ V_{DD} +0.3	V
I_F	Fault Current	Sink Current at V_F pin	5	mA
V_{SC}	Current Sensing Input Voltage	Applied between C_{SC} - COM	-0.3 ~ V_{DD} +0.3	V

Total System

Symbol	Parameter	Conditions	Rating	Unit
$V_{PN(PROT)}$	Self Protection Supply Voltage Limit (Short Circuit Protection Capability)	V_{DD} = V_{BS} = 13.5 ~ 16.5 V T_J = 150°C, Non-Repetitive, < 2 µs	400	V
T_{STG}	Storage Temperature		-40 ~ 125	°C
V_{ISO}	Isolation Voltage Connect Pins to Heat Sink Plate	AC 60 Hz, Sinusoidal, 1 Minute	1500	V_{rms}

Thermal Resistance

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
$R_{th(j-c)Q}$						

Note:

6. For the measurement point of case temperature (T_C), please refer to Figure 2.

Electrical Characteristics (T_J = 25°C, unless otherwise specified.)

Inverter Part

Symbol	Parameter	Conditions		Min.	Typ.	Max.	Unit
$V_{CE(SAT)}$	Collector - Emitter Saturation Voltage	$V_{DD} = V_{BS}$ = 15 V V_{IN} = 5 V I_C = 4 A	T_J = 25°C	-	1.9	2.25	V
			T_J = 150°C		2.4		V
V_F	FWDi Forward Voltage	V_{IN} = 0 V I_F = 4 A	T_J = 25°C	-	2.2	2.55	V
			T_J = 150°C		2.0		V
HS t_{ON}	Switching Times	V_{PN} = 400 V, V $_{= 400\ V}$ V					

Note:

7. t_{ON} and t_{OFF} include the propagation delay of the internal drive IC. $t_{C(ON)}$ and $t_{C(OFF)}$ are the switching time of IGBT itself under the given gate driving condition internally. For the detailed information, please see Figure 4.

Figure 4. Switching Time Definition

Control Part

Symbol	Parameter	Conditions		Min.	Typ.	Max.	Unit
I_{QDD}	Quiescent V_{DD} Supply Current	V_{DD} = 15 V, $IN_{(UH,VH,WH,UL,VL,WL)}$ = 0 V	V_{DD} - COM	-	2.3	3.4	mA
I_{PDD}	Operating V_{DD} Supply Current	V_{DD} = 15 V, f_{PWM} = 20 kHz, duty = 50%, applied to one PWM signal input	V_{DD} - COM	-	2.7	4.0	mA
I_{QBS}	Quiescent V_{BS} Supply Current	V_{BS} = 15 V, $IN_{(UH, VH, WH)}$ = 0 V	$V_{B(U)}$ - $V_{S(U)}$, $V_{B(V)}$ - $V_{S(V)}$, $V_{B(W)}$ - $V_{S(W)}$	-	60	100	µA
I_{PBS}	Operating V_{BS} Supply Current	V_{DD} = V_{BS} = 15 V, f_{PWM} = 20 kHz, duty = 50%, applied to one PWM signal input for high - side	$V_{B(U)}$ - $V_{S(U)}$, $V_{B(V)}$ - $V_{S(V)}$, $V_{B(W)}$ - $V_{S(W)}$	-	250	400	µA
V_{FH}	Fault Output Voltage	V_{SC} = 0 V, V_F Circuit: 4.7 kΩ to 5 V Pull-up		4.5	-	-	V
V_{FL}		V_{SC} = 1 V, V_F Circuit: 4.7 kΩ to 5 V Pull-up		-	-	0.5	V
$V_{SC(ref)}$	Short-Circuit Trip Level	V_{DD} = 15 V (Note 4)		0.45	0.5	0.55	V
UV_{DDD}	Supply Circuit Under-Voltage Protection	Detection level		10.0	11.5	13.0	V
UV_{DDR}		Reset level		10.5	12.0	13.5	V
UV_{BSD}		Detection level		9.5	11.0	12.5	V
UV_{BSR}		Reset level		10.0	11.5	13.0	V
I_{FT}	HVIC Temperature Sensing Current	V_{DD} = V_{BS} = 15 V, T_{HVIC} = 25°C		70	95	120	µA
V_{FT}	HVIC Temperature Sensing Voltage	V_{DD} = V_{BS} = 15 V, T_{HVIC} = 25°C, 4.7 kΩ to 5 V Pull-up (Figure. 5)		-	4.55		V
t_{FOD}	Fault-Out Pulse Width			40	100	-	µs
V_{FSDR}	Shut-down Reset level	Applied between V_F - COM		-	-	2.4	V
V_{FSDD}	Shut-down Detection level			0.8	-	-	V
$V_{IN(ON)}$	ON Threshold Voltage	Applied between $IN_{(UH)}$, $IN_{(VH)}$, $IN_{(WH)}$, $IN_{(UL)}$, $IN_{(VL)}$, $IN_{(WL)}$ - COM		-	-	2.4	V
$V_{IN(OFF)}$	OFF Threshold Voltage			0.8	-	-	V

Note:

8. Short-circuit protection is functioning for all six IGBTs.

Figure. 5. V-T Curve of Temperature Output of IC (5V pull-up with 4.7kohm)

Recommended Operating Conditions

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_{PN}	Supply Voltage	Applied between P - N_U, N_V, N_W	-	300	400	V
V_{DD}	Control Supply Voltage	Applied between V_{DD} - COM	14.0	15	16.5	V
V_{BS}	High - Side Bias Voltage	Applied between $V_{B(U)}$ - $V_{S(U)}$, $V_{B(V)}$ - $V_{S(V)}$, $V_{B(W)}$ - $V_{S(W)}$	13.0	15	18.5	V
dV_{DD} / dt, dV_{BS} / dt	Control Supply Variation		-1	-	1	V / µs
t_{dead}	Blanking Time for Preventing Arm - Short	For each input signal	0.5	-	-	µs
f_{PWM}	PWM Input Signal	- 40°C T_J 150°C	-	-	20	kHz
V_{SEN}	Voltage for Current Sensing	Applied between N_U, N_V, N_W - COM (Including surge voltage)	-4		4	V
$P_{WIN(ON)}$	Minimun Input Pulse Width					

Note:

9. This product might not make response if input pulse width is less than the recommanded value.

Note:

10. RC coupling at each input (parts shown dotted) might change depending on the PWM control scheme used in the application and the wiring impedance of the application's printed circuit board. The input signal section of the SPM 55 product integrates 5 kΩ (typ.) pull-down resistor. Therefore, when using an external filtering resistor, please pay attention to the signal voltage drop at input terminal.

Figure 6. Recommended MCU I/O Interface Circuit

Mechanical Characteristics and Ratings

Figure 7. Flatness Measurement Position

Figure 8. Mounting Screws Torque Order

Note:

11. Do not make over torque when mounting screws. Much mounting torque may cause package cracks, as well as bolts and Al heat-sink destruction.

(with the external shunt resistance and CR connection)

c1 : Normal operation: IGBT ON and carrying current.

c2 : Short circuit current detection (SC trigger).

c3 : Hard IGBT gate interrupt.

c4 : IGBT turns OFF.

c5 : Input “L” : IGBT OFF state.

c6 : Input “H”: IGBT ON state, but during the acti

Note:

1) To avoid malfunction, the wiring of each input should be as short as possible. (less than 2 ~ 3 cm)

2) By virtue of integrating an application specific type of HVIC inside the SPM® 55 product, direct coupling to MCU terminals without any opto-coupler or transformer isolation is possible.

3) V_F is open-drain type. This signal line should be pulled up to the positive side of the MCU or control power supply with a resistor that makes I_{FO} up to 5 mA. Please refer to Figure 14.

4) C_{SP15} of around seven times larger than bootstrap capacitor C_{BS} is recommended.

5) Input signal is active-HIGH type. There is a 5 kΩ resistor inside the IC to pull down each input signal line to GND. RC coupling circuits is recommanded for the prevention of input signal oscillation. $R_S C_{PS}$ time constant should be selected in the range 50 ~ 150 ns. (Recommended R_S = 100 Ω, C_{PS} = 1 nF)

6) To prevent errors of the protection function, the wiring around R_F and C_{SC}

Detailed Package Outline Drawings (FNB51060T1, Short Lead)

Package drawings are provided as a service to customers considering Fairchild components. Drawings may change in any manner without notice. Please note the revision and/or data on the drawing and contact a FairchildSemiconductor representative to verify or obtain the most recent revision. Package specifications do not expand the terms of Fairchild's worldwide therm and conditions, specifically the the warranty therein, which covers Fairchild products.

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